

Oryzalin

Roadside Vegetation Management Herbicide Fact Sheet



This fact sheet was developed by Oregon State University and Intertox, Inc. to assist interested parties in understanding the risks associated with pesticide use in Washington State Department of Transportation's (WSDOT) Integrated Vegetation Management program.

Introduction

Oryzalin is a selective, surface-applied herbicide used to control annual grasses and broadleaf weeds. It inhibits the growth of germinating weed seeds. Oryzalin is the active ingredient (40.4%) in the herbicides **Surflan AS** and **Oryzalin AS** used by the Washington State Department of Transportation (WSDOT) for pre-emergent (before plant growth begins) control of grass and weeds in ground cover beds. Oryzalin also has agricultural, forestry, and urban uses.

WSDOT assessed the potential risks to humans, wildlife, and aquatic animals exposed to oryzalin in their Integrated Vegetation Management (IVM) program. Evaluating potential risks takes into account both the toxicity of a pesticide and the characteristics of possible exposure.

Application Rates and Use Patterns on Highway Rights-of-Way

Typical rights-of-way application rates of Surflan and Oryzalin AS range from 64 to 128 ounces of product – or a maximum of about 4 pounds of oryzalin -- per acre. Applicators use truck-mounted handguns, hose reels, or backpack sprayers to apply Surflan from November to March. WSDOT workers applied an average of 400 pounds of oryzalin per year statewide in 2004 and 2005.

Human Health Effects

The United States Environmental Protection Agency (EPA) classifies Surflan as toxicity class III (low toxicity) with a signal word of CAUTION (see Toxicity Category and Signal Word table).

Laboratory Testing: Before pesticides are registered by the U.S. Environmental Protection Agency (EPA), they must undergo laboratory testing for short-term (acute) and long-term (chronic) health effects. Laboratory animals are purposely fed doses high enough to cause toxic effects. These tests help scientists determine how chemicals might affect humans, domestic animals, or wildlife in cases of overexposure. Pesticide products used according to label directions are unlikely to cause toxic effects. The amount of pesticide that people and pets may be exposed to is low compared to the doses fed to laboratory animals.

Acute toxicity: Oryzalin has low to very low toxicity if individuals accidentally eat, touch, or inhale residues. Oryzalin is slightly irritating to the eyes and skin and is a skin sensitizer (see Laboratory Testing text box).

Chronic toxicity: Oryzalin causes some changes in blood parameters and organ weights when fed to rats, mice, and dogs for one or two years at moderate to high doses.

Reproductive effects: Oryzalin did not affect reproduction or survivability when fed to rats over one to three generations, although there were slight changes in growth. The offspring of laboratory rats and rabbits fed moderate to high doses of oryzalin during pregnancy showed some delays in bone formation, decreased litter size, and decreased body weight.

Toxicity Category and Signal Word

	High Toxicity (Danger)	Moderate Toxicity (Warning)	Low Toxicity (Caution)	Very Low Toxicity (Caution)
Oral LD50	Less than 50 mg/kg	50-500 mg/kg	500-5000 mg/kg	Greater than 5000 mg/kg
Dermal LD50	Less than 200 mg/kg	200-2000 mg/kg	2000-5000 mg/kg	Greater than 5000 mg/kg
Inhalation LC50	Less than 0.05 mg/l	0.05-0.5 mg/l	0.5-2.0 mg/l	Greater than 2.0 mg/l
Eye Effects	Corrosive	Irritation persisting for 7 days	Irritation reversible in 7 days	Minimal effects, gone in 24 hrs
Skin Effects	Corrosive	Severe irritation at 72 hours	Moderate irritation at 72 hours	Mild or slight irritation

Highlighted categories specify the range for oryzalin use cited in this fact sheet.

Carcinogenic effects: Rats (but not mice) fed moderate to high doses of oryzalin for 2 years showed an increase in the incidence of thyroid gland, skin, and mammary tumors. The EPA lists oryzalin as a Group C human carcinogen (possible human carcinogen).

Fate in humans and animals: Oryzalin is easily absorbed from the gut and is rapidly metabolized (broken down) and eliminated. Male rats given oryzalin excreted 40% of the dose in the urine and 40% of the dose in the feces within 3 days. Tests with rabbits, Rhesus monkeys, and a steer gave similar results.

LD50/LC50: Acute toxicity is commonly measured by the lethal dose (LD) or lethal concentration (LC) that causes death in 50 percent of treated laboratory animals. LD50 indicates the dose of a chemical per unit body weight of an animal and is expressed as milligrams per kilogram (mg/kg). LC50 is the concentration of a chemical per volume of air or water and is expressed as milligrams per liter (mg/L). Chemicals are highly toxic when the LD50 or LC50 value is small and practically nontoxic when the value is large. However, the LD50 and LC50 do not reflect potential health effects such as cancer, birth defects, or reproductive toxicity that may occur at levels of exposure below those that cause death.

Wildlife and Aquatic Effects

Effects on mammals: Oryzalin is slightly toxic to practically non-toxic to mammals (see LD50/LC50 text box and Wildlife Toxicity Category table). The acute oral LD50 is greater than 5,000 milligrams per kilogram (mg/kg) in rats and mice and greater than 1,000 mg/kg in cats, dogs, and chickens. The LD50 for rabbits exposed by skin contact is greater than 2,000 mg/kg. Oryzalin causes slight skin and eye irritation. Oryzalin did not cause skin sensitization in guinea pigs.

Effects on birds: Oryzalin is slightly to practically non-toxic to birds. The LD50 is 507 mg/kg in northern bobwhite quail and mallards and greater than 1,000 mg/kg in chickens.

Effects on fish: Oryzalin is moderately toxic to fish. The LC50 of oryzalin after a 96-hour exposure period is 2.88 milligrams per liter (mg/L) in bluegill sunfish, 3.26 mg/L in rainbow trout, and greater than 1.4 mg/L in goldfish fingerlings.

Effects on aquatic insects: Oryzalin is slightly toxic to highly toxic to aquatic insects.

Wildlife Toxicity Category

Risk Category	Mammals	Birds	Fish and Aquatic Insects
	Acute Oral or Dermal LD₅₀ (mg/kg)	Acute Oral LD₅₀ (mg/kg)	Acute LC₅₀ (mg/L)
Practically nontoxic	>2,000 ¹	>2,000	>100
Slightly toxic	501-2,000	501-2,000	>10-100 ²
Moderately toxic	51-500	51-500	>1-10
Highly toxic	10-50	10-50	0.1-1
Very highly toxic	<10	<10	<0.1

¹ Highlighted categories specify the range for oryzalin use cited in this fact sheet.

² The toxicity of oryzalin to fish and aquatic insects varies depending on the specific fish or insect species that are exposed.

Environmental Fate

The half-life of oryzalin in the field ranges from 20 to 128 days with a typical time of 20 days in soil (see Half-life text box). Microbes break it down. Oryzalin is only slightly mobile in the environment but may pose a risk of contaminating groundwater if soils have low organic matter or low clay content and when there is increased rainfall or high water tables.

Human Health Risk Assessment

WSDOT evaluated several human exposure scenarios, including workers who prepare, load, and apply the herbicide, and members of the public who walk, hike, or jog in sprayed vegetation, or who pick or eat drift-contaminated berries or vegetables. For each exposure scenario, WSDOT evaluated conditions of average exposure and extremely conservative conditions of maximum exposure (see Human Cancer/Non-cancer Risk Classification text box and Human Risk Classifications under Conditions of Average Exposure table).

Oryzalin poses a negligible risk of adverse non-cancer effects to WSDOT workers and the public under average exposure scenarios. All hazard quotients are below 1. However, under maximum exposure scenarios, oryzalin poses a low risk of adverse non-cancer effects to adults and children ingesting drift-contaminated garden vegetables, with hazard quotients of 4.4 and 5.7, respectively. Hazard quotients for all other maximum public exposure scenarios are below 1. Under conditions of maximum exposure, oryzalin poses a low risk to WSDOT workers making broadcast hydraulic spray applications with a hazard quotient of 5.4 and direct foliar applications with a hazard quotient of 1.2. Non-cancer risks to workers are negligible under conditions of average exposure.

The estimated cancer risks for all average public exposure scenarios are negligible. The cancer risk estimates for WSDOT workers making broadcast hydraulic spray applications and direct foliar applications, under conditions of average exposure, are low (3.6×10^{-5} and 2.1×10^{-5} , respectively). Potential cancer risks for all public maximum exposure scenarios are greater than 1×10^{-5} and represent low to moderate risks. The risk estimates range from 1.4×10^{-5} for dermal contact with drift-contaminated berries to 9.4×10^{-4} for ingestion of drift-contaminated garden vegetables. Potential cancer risks under conditions of maximum exposure for WSDOT workers making broadcast hydraulic spray applications and direct foliar applications are 1.1×10^{-3} and 2.4×10^{-4} , respectively, signifying moderate risks.

Half-life is the time required for half of the compound to degrade.

1 half-life	= 50% degraded
2 half-lives	= 75% degraded
3 half-lives	= 88% degraded
4 half-lives	= 94% degraded
5 half-lives	= 97% degraded

Remember: the amount of a chemical remaining after a half-life will always depend on the amount of the chemical originally applied.

Human Risk Classifications under Conditions of Average Exposure

Human Cancer/Non-cancer Risk Classification:

Scientists estimate non-cancer health risks by generating a hazard quotient (HQ). This number is the exposure divided by the toxicity. When the HQ is less than 1, exposures are unlikely to cause any adverse health effects. When the HQ is greater than 1, potential non-cancer health effects may be possible. Risk assessments for chemicals that cause cancer (carcinogens) estimate the probability of an individual developing cancer over a lifetime. Cancer risks estimated in this way are very conservative, and actual cancer risks are likely to be much lower. Cancer risk estimates of less than 1 in 100,000 are within the range considered negligible by most regulatory agencies.

Hazard Quotient (Non-cancer Risk)	Cancer Risk	Potential Risks and Management Priority
Less than 1	Less than 1 in 100,000	Negligible
Between 1 and 10	Between 1 in 10,000 and 1 in 100,000	Low¹
Between 10 and 100	Between 4 in 1,000 and 1 in 10,000	Moderate
Greater than 100	Greater than 4 in 1,000	High

Note: Highlighted categories specify the range of potential risk for specific exposure scenarios involving oryzalin.

¹Low risks involving oryzalin are specific to WSDOT workers.

Wildlife Risk Assessment

Wildlife risk assessment considers pesticide behavior in the environment and routes of exposure. Indirect exposure to mammals and birds can occur when they eat contaminated prey or vegetation. Direct exposure can occur when mammals and birds contact pesticide residues with their skin or eyes or when they inhale vapors or particulates.

Estimated dietary exposures for rats, mice, and meadow voles are approximately 100 to 900 times lower than the rat LD50 of >5,000 mg/kg. WSDOT's current application rates and use patterns for oryzalin pose a negligible risk to rats and a low risk to mice and meadow voles. Estimated dietary exposures to quail, marsh wrens, and American robins are approximately 5 to 60 times lower than the bobwhite quail LD50 of greater than 1,000 mg/kg. WSDOT's current application rates and use patterns for oryzalin pose a low risk to quail and a high risk to marsh wrens and American robins.

Aquatic Risk Assessment

WSDOT takes extra precautions applying herbicides near open water, wetlands, and near wellhead protection zones. However, contamination may result from application drift, rainfall runoff, or residue leaching through the soil into groundwater. Fish and aquatic insect exposure to oryzalin occurs primarily through direct contact with contaminated surface waters. WSDOT's current application rates and use patterns for oryzalin pose a low risk to fish and aquatic insects in all areas of the state.

Additional Resources

- National Pesticide Information Center 1-800-858-PEST (7378) and <http://npic.orst.edu>
- Extension Toxicology Network (EXTOXNET) <http://extoxnet.orst.edu>
- Washington State Department of Transportation, Roadside Maintenance Branch 1-360-705-7865
- Washington Department of Agriculture, Pesticide Management Division 1-877-301-4555 (toll free)